



# **CO-OPS Water Level and Meteorological Site Reconnaissance Procedures**

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## **TABLE OF CONTENTS**

<b>1. INTRODUCTION</b>	<b>1</b>
<b>2. BACKGROUND</b>	<b>1</b>
<b>3. TYPES OF STATIONS</b>	<b>2</b>
<b>4. EQUIPMENT NEEDED</b>	<b>3</b>
<b>5. OFFICE INFORMATION</b>	<b>3</b>
<b>6. SITE VISIT</b>	<b>5</b>
<b>APPENDIX A – SITE RECONNAISSANCE FIELD NOTE</b>	<b>7</b>

# 1. Introduction

The National Ocean Service (NOS), Center for Operational Oceanographic Products and Services (CO-OPS), operates a number of short and long term monitoring systems. CO-OPS provides the infrastructure, science, and technical expertise to monitor, assess, and disseminate coastal oceanographic and Great Lakes products and services necessary to support NOS missions of environmental stewardship, assessment, and prediction; safe navigation; and hazard mitigation.

In order to support the NOS and CO-OPS missions, new water level and met stations are regularly required. The best method for assembling the information needed to install these stations is a reconnaissance. The primary objective of the reconnaissance is to determine the optimal location and configuration for data collection platforms (DCP), antennas, sensors, and support components. For a water level station, recovering historic bench marks and scouting locations for setting new bench marks is also essential. The reconnaissance consists of personnel visiting the site sufficiently far in advance of site preparation to:

- Locate an acceptable site.
- Obtain measurements and information necessary to design the station.
- Arrange for any permits/license agreements required.
- Arrange for utilities.
- Prepare a cost estimate and work schedule.
- Allow time for the procurement and fabrication of special support components (if necessary).

If possible, property owners should be contacted in advance to obtain oral or written permission to use or modify the site, otherwise, meet with the property owner as soon as site is visited. An advance letter of permission, permit, security clearance, or some other written instrument may be required by the owner. A license agreement may have to be executed before any work can be done. Even if the site is an existing NWLON station, some advance notice may be required or appreciated by the owner.

Accurate measurements and information is best obtained onsite. The locale can be investigated to determine which particular site will best accommodate the preliminary design and all the other site requirements. Any special installation requirements, such as explosion proof conduit on fuel piers, can also be determined through discussions with local authorities.

Once the reconnaissance information is collected and a report issued, the design is finalized, and a cost estimate and installation schedule can be determined.

# 2. Background

NOS is a Federal agency devoted to exploring, understanding, conserving, and restoring the Nation's coasts and oceans. NOS promotes safe navigation, supports coastal communities, sustains coastal habitats, and mitigates coastal hazards. NOS balances environmental

protection with economic prosperity and leads the effort to ensure that our Nation's coastal areas remain safe, healthy and productive.

CO-OPS establishes standards for the acquisition and processing of water level and current data; collects and documents user requirements that serve as the foundation for all resulting program activities; designs new and/or improved oceanographic observing systems; develops software to improve data processing capabilities; maintains and operates oceanographic observing systems; performs operational data analysis/quality control; produces/disseminates oceanographic products; and archives the resulting oceanographic data.

A water level station is a stand alone system that collects, stores, and transmits water level, meteorological, and other environmental data. The primary requirement of a station is to accurately measure water level information with low power consumption, high reliability, and defined accuracy. The typical station includes an air acoustic water level sensor with protective well, single or dual orifice Paroscientific pressure sensors, or a shaft angle encoder in a sump (Great Lakes); a redundant pressure-based water level sensor; and a data collection platform with Geostationary Operational Environmental Satellite (GOES) transmitter, rechargeable battery, and solar panel. Many stations also include sensors that measure air and water temperature, wind speed and direction, barometric pressure, and conductivity. A meteorological (Met) only station is a stand alone system that collects, stores, and transmits meteorological data.

### 3. Types of Stations

There are several types of stations that CO-OPS maintains. They are:

- Basic Water Level Station
  - a) Support structure (pier, platform, wharf, etc.).
  - b) DCP
  - c) DCP enclosure
  - d) Water level sensor (acoustic or pressure)
  - e) Protective well (for acoustic sensor)
  - f) Protective well brackets
  - g) Solar Panel
  - h) GOES antenna
  - i) Bench mark network (minimum of five marks)
- NWLON Station
  - a) Basic water level station with acoustic water level sensor
  - b) Multiple DCPs
  - c) Redundant pressure water level sensor
  - d) Bench mark network of ten marks
  - e) Additional solar panels
  - f) Barometer
  - g) Wind sensor
  - h) Tower or pole for mounting wind sensor
  - i) Air temperature sensor

- j) Water temperature sensor
  - k) Conductivity
  - l) Utilities (phone and electric)
- PORTS Water Level Station
  - a) NWLON Station
  - b) Line of sight radio
  - c) IP modem
- Met Station
  - a) DCP
  - b) DCP enclosure
  - c) Barometer
  - d) Wind sensor
  - e) Tower or pole for mounting wind sensor
  - f) Air temperature sensor
  - g) Solar Panel
  - h) GOES antenna
  - i) Line of sight radio (for PORTS)
  - j) IP modem (for PORTS)

## 4. Equipment Needed

The following equipment, forms, and information is needed to perform a complete reconnaissance:

- Digital Camera/Videotape Recorder
- Published Bench Mark Sheet
- NGS Datasheets for area
- Shovel/digging implement
- Metal detector
- Sample License Agreement/Letter of Permission
- Weighted tape for soundings
- Engineering sketch pad
- Inclinator
- Carpenters level or plumb bob
- Hand-held GPS
- Compass
- Chart section
- NGWLMS Well/Sounding Tube Worksheet
- Site Reconnaissance Field Notes form (Appendix A)

## 5. Office Information

After a general site has been selected for the installation of a water level or met station, the first step is to gather all relevant information. In many cases, the site is an existing or historic water level station, and office files can be consulted for much of the information. To find out if an historic water level station exists, consult the Index of Water Level Stations at

[http://www.co-ops.nos.noaa.gov/station\\_index\\_map.shtml](http://www.co-ops.nos.noaa.gov/station_index_map.shtml) Program requirements may also provide some direction.

If there is a historical site, assemble as much of the following information as possible:

- Tidal datums and bench mark elevations.
- To Reach statement and bench mark recovery notes.
- NGS Datasheets based on point radius.
- Support structure and harbor bottom elevations.
- Support structure plan and sun transit.
- Environmental data.
- Instrument shelter and utilities description.
- GOES transmission information (azimuth and elevation).
- Solar incidence.
- Ancillary sensor(s) requirements.

Tidal datums are required to determine the length and elevation of the protective well. Observed highest/lowest water levels shall be used at long term control stations. Estimated highest/lowest water levels shall be used at short term stations. These estimated values can be determined using a tidal prediction program such as Tides & Currents. Ensure that the tidal datums are based on the National Tidal Datum Epoch (1983-2001). To Reach statements and bench mark recovery notes are needed to find the historic site and recover as many historic bench marks as possible. This information can be found on the CO-OPS published bench mark sheet web page <http://tidesandcurrents.noaa.gov/bench.html>

Datasheets retrieved from the NGS web site are essential for replacing destroyed historic marks and for providing a connection to the North American Vertical Datum of 1988 (NAVD88). The web site is [http://www.ngs.noaa.gov/cgi-bin/ds\\_radius.prl](http://www.ngs.noaa.gov/cgi-bin/ds_radius.prl)

Support structure and harbor bottom elevations are required as they may impose physical constraints on the protective well and backup sensor mounting assembly elevations and lengths. These elevations typically have been documented for existing NWLON stations and can be determined at historic sites through levels to the bench mark network.

Information on the support structure's orientation and the path of the sun's transit is critical for locating a thermally acceptable site for the protective well.

Descriptions of the instrument shelter and utilities are typically available for NWLON sites and can be used to determine if adequate space and utilities exist for the DCP units.

The GOES satellite antenna azimuth and elevation angles are required to select an antenna site free of obstructions that may interfere with the transmission. GOES satellite azimuths are referenced in true degrees. If a compass is used to position the antenna, the local magnetic declination must be applied.

Solar incidence is needed to provide the proper orientation and elevation of the solar panel to provide maximum charging voltage.

Requirements for ancillary sensors should be determined in advance to allow adequate lead time for site preparation configuration and installation.

Site specific environmental data, particularly on wave climate, is important. Wave data are used in determining well length and elevation. Other types of environmental data may also be useful for design or validation processes.

Once a general location has been selected, use nautical charts, quad maps, and aerial photographs to search for likely structures

## **6. Site Visit**

After compiling all information possible in the office, it is time to visit the site. Upon arrival at the general location, proceed to the site determined from the office documents. Seek out the owner or owners representative of the structure most likely for the installation, introduce yourself and explain your purpose. Ask permission to make measurements and determine which method the owner wishes to use to grant permission for CO-OPS to install equipment on the owner's property. Use the Site Reconnaissance Field Notes form in Appendix A to record all information.

Following receipt of owner permission, perform the following measurements at the structure:

- Pier/Bulkhead surface above harbor bottom
- Pier/Bulkhead surface above water surface
- Time of Pier/Bulkhead to water surface measurement
- Piling diameter
- Pier stringer size and separation
- Pier deck width

Record contact information for the following individuals:

- Facility owner
- Local contact – the person who must be notified whenever the station is visited.

Make the following observations:

- Sky clearance in the direction of the GOES antenna and solar panels.
- For wind sensor installations, choose an area free of obstructions that affect the path of the wind.
- GPS latitude/longitude of station & bench mark locations. Record position to the thousandths of a second.

Take digital photographs of the following:

- Proposed location of protective well
- Proposed location of DCP
- Recovered bench marks
  - a) Bench mark faces



- b) At least two distance photos from different directions showing landmarks in the background.
- Locations for new marks

## **7. Documentation**

Submit the following documentation upon completion of the reconnaissance:

- Site Reconnaissance Field Notes
- Bench Mark recovery notes
- All digital photos of bench marks, proposed DCP & well locations, and proposed bench mark installation locations if insufficient marks recovered.
- Site view drawing showing proposed DCP location(s); proposed protective well locations; North directional arrow; recovered bench marks; proposed bench mark install location(s); and solar incidence at protective well location(s).

## **Appendix A – Site Reconnaissance Field Note**



**National Oceanic and Atmospheric Administration  
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Site Reconnaissance Field Notes

GENERAL SITE INFORMATION			
Station Number	Station Name	Date	
Project Name	Station Type	Permanent; Temporary; NWLON; Navigation; Hydro; COASTAL; Other	
Site Name	Site Location		
	City	County	State      Zip code
How To Reach			
Property Owner: Address: Phone: Cell Phone: Fax:		Local Contact: Address: Phone: Cell Phone: Fax:	
Communications or Agreements Made To Date			Contact dates? Letter, phone or meeting? Details of Discussion? Follow-up needed? MOU or permits needed?
SITE DESCRIPTION		GEOGRAPHIC/OCEANIC DESCRIPTION	
Facility	Public; Private; Government; Industrial; Commercial; Residential  Accessibility	Geographic & Hydraulic Features	Open Coast; Sheltered Harbor; Bay; Sound; Marsh  Tide Range; Wave Height; Currents
Support Structure	Bulkhead; Pier; Pilings; Other Wood; Concrete; Steel  Measurements & Sizes  Additional Bracing Necessary?	Shoreline/Bottom Characteristics	Sand; Sediment; Gravel; Stone; Rocks; Bedrock  Bottom Slope  Shifting Shoals? Erosion? Scouring?
Structure Height Above Bottom = Above Water Surface = Time of Measurement =  Water Depth		Marine Growth	Light; Heavy; Kelp; Weeds; Barnacles; Mussels
		Proposed Sensor & DCP Locations	
INSTRUMENTATION		SUPPORT STRUCTURES	
Data Collection Platform To Be Installed		Type Of Shelter To Be Used	
Sensor(s) To Be Installed		Type & Length Of Well	
		Clamps Required	

TOOLS/SUPPLIES	
Special Tools or Equipment Required	Boat Jet Pump Pneumatics Hydraulics Generator Welder Diving
Supply List	Lumber Hardware Pipes
Nearby Supplies/Services	
VERTICAL CONTROL/BENCHMARKS	
Level Procedures to be Performed	2nd Order, Class 1 3rd Order, Class 1 Other
Bench Marks (Designation/Stamping/Mark Type/Setting/Stability Code)	# Recovered # to be Installed Estimated length of run Quality of Bench Marks GPS Suitability
SERVICES/UTILITIES	
Telephone Requirements	# of lines required Origination Point Length of run Overhead/trench Estimated cost Type of cable Type of conduit
Telephone Company Info	Name Number Mail Address Contact
Electrical Requirements	# of lines required Origination Point Length of run Overhead/trench Estimated cost Type of cable Type of conduit
Electrical Contractor Info	Name Number Mail Address Contact
Other Contractors Info	Marine Concrete Diving Welding Price quotes received
Additional Information	